A

Connector Pin Assignments

The tables in this appendix list the pin assignments for each connector on the CPU assembly and the preview display boards. Following each table is a dictionary of the signal names listed in the table. Signal names that begin with a lowercase n are active low signals. NC means no connection to a pin. Refer to Figure 5-2 and Figure 5-12 to see how the system interconnects.

CPU Assembly Connectors

Refer to Figure 7-20 for the CPU assembly connector locations.

Note

The system's 5 V power supply is divided into several circuits, each of which is passively filtered for EMI. Therefore, the +5V signal shown in the pin assignment tables does not always represent the same filtered 5 volt circuit.

Table A-1.
Keyboard and Keyboard Display (LCD) Connector J1

Pin	Signal	Pin	Signal
1	GROUND	14	GROUND
2	+5V	15	LCDRS
3	GROUND	16	VLCD
4	nONKEY	17	LCDE
5	GROUND	18	LCDRW
6	ACONLED	19	LCDDATA(1)
7	GROUND	20	LCDDATA(0)
8	KRX	21	LCDDATA(3)
9	KBD RESET	22	LCDDATA(2)
10	KTX	23	LCDDATA(5)
11	GROUND	24	LCDDATA(4)
12	GROUND	25	LCDDATA(7)
13	+5V	26	LCDDATA(6)

Note

The connector listed in this table is shared by the keyboard and the keyboard display. Pins 1–11 serve the keyboard, while pins 12–26 serve the keyboard display. All of the signal lines (except ground) are filtered before they pass through this connector.

Signal	Definition
ACONLED	AC on LED. Drives the AC indicator LED on the keyboard.
KBD RESET	Keyboard controller reset.
KRX	Keyboard receive—data from the CPU assembly.
KTX	Keyboard transmit—data to the CPU assembly.
LCDDATA	Eight data bits for keyboard LCD.
LCDE	LCD Enable—active high.
LCDRS	Control that identifies data as display or instruction.
LCDRW	LCD Read/Write control—read high, write low.
nONKEY	Signal generated by On-Standby key—active low. Initiates the DRAM gate array during power-up.
VLCD	Contrast voltage to the keyboard display (LCD).

Table A-2. Printhead Logic Connector J2

Pin	Signal	Pin	Signal
1	+5V	14	VTHERM
2	+5V	15	nPSTB
3	PDOUT	16	NC
4	GROUND	17	nPSTB
5	nPSTB	18	NC
6	GROUND	19	nPSTB
7	nPSTB	20	GROUND
8	NC	21	nLATCH
9	nPSTB	22	GROUND
10	NC	23	PRCLK
11	nPSTB	24	GROUND
12	5VREF	25	NC
13	nPSTB	26	GROUND

Signal	Definition
5VREF	Reference voltage from the pulse width monitor (PWM) in the +5 volt supply. Valid when the cardiograph is **On**.
nLATCH	Printhead latch—latches a line of print data.
nPSTB	Printhead strobe—enables the dot drivers.
PDOUT	Print data output to printhead.
PRCLK	Printhead clock. Clocks serial data into printhead at 4 MHz.
VTHERM	Voltage from printhead thermistor—indicates printhead temperature.

Table A-3. Printer Motor and Sensor Connector J3

Pin	Signal	Pin	Signal
1	VPRINT	8	P3
2	GROUND	9	GROUND
3	P4	10	DETECTOR
4	VMOTOR	11	GROUND
5	P2	12	GROUND
6	P1	13	EMITTER
7	VMOTOR	14	DOOR

Signal	Definition
DETECTOR	Paper sensor detector.
DOOR	Indicates the state of the printer compartment door. High when door closed.
EMITTER	Paper sensor emitter.
P1–P4	Drive signals for the printer's four-phase stepper motor.
VPRINT	Switched battery voltage to the printhead. Enabled with +5READY signal.
VMOTOR	Power to the motor. Enabled with +5READY signal.

Table A-4. Battery Connector J4

Pin	Signal
1	THERM–
2	THERM+
3	GROUND
4	NOBATT
5	VBAT–
6	VBAT–
7	VBAT+
8	VBAT+

Signal	Definition
NOBATT	Indicates the battery's presence. Low while battery is installed.
THERM–	Connects to the thermistor in the battery assembly.
THERM+	Connects to the thermistor in the battery assembly.
VBAT–	Battery negative terminal—connected to ground through a resistor.
VBAT+	Battery positive terminal—connected to VBAT voltage line through a fuse.

Table A-5. Printhead Power Connector J5

Pin	Signal	Pin	Signal
1	VPRINT	8	GROUND
2	VPRINT	9	GROUND
3	VPRINT	10	GROUND
4	VPRINT	11	GROUND
5	VPRINT	12	GROUND
6	VPRINT	13	GROUND
7	VPRINT	14	GROUND

Signal	Definition
VPRINT	Power to the printhead. Enabled with +5READY signal.

Table A-6. Patient Module Connector J9

Pin	Signal
1	GROUND
2	RFECLK
3	GROUND
4	RFEDATA
5	VFE
6	QRFEDATA
7	GROUND
8	GROUND
9	GROUND
CASE	GROUND

Signal	Definition
QRFEDATA	Output signal to the patient module.
RFECLK	Clock input from the patient module.
RFEDATA	Data input from the patient module.
VFE	Regulated voltage for patient module.

Table A-7. RS-232 Connector J10

Pin	Signal
1	DCD
2	RXD
3	TXD
4	DTR
5	GROUND
6	DSR
7	RTS
8	CTS
9	RI
CASE	GROUND

Signal	Definition
DCD	Data clear device. RS-232 handshaking signal.
nCTS	Clear to send. RS-232 signal.
nDTR	UART output.
RI	Ring in. RS232 signal.
RTS	Ready to send. RS232 signal.
RXD	Received data. UART input.
TXD	Transmit data. UART output.

Table A-8. System Expansion Connector J12

Pin	Row A	Row B	Row C	Pin	Row A	Row B	Row C
1	+5V	GROUND	MIOn	17	nRDY	BT0	GROUND
2	A(17)	A(9)	A(1)	18	GROUND	GROUND	NC
3	A(18)	A(10)	A(2)	19	nLOCK	IBIT2	OBIT1
4	A(19)	A(11)	A(3)	20	INTR	INT7	nADS
5	A(20)	A(12)	A(4)	21	GROUND	GROUND	GROUND
6	A(21)	A(13)	A(5)	22	ADS	D(8)	D(0)
7	A(22)	A(14)	A(6)	23	DCn	D(9)	D(1)
8	A(23)	A(15)	A(7)	24	LCDRS	D(10)	D(2)
9	GROUND	A(16)	A(8)	25	nRD	D(11)	D(3)
10	TURBO	GROUND	GROUND	26	nWEL	D(12)	D(4)
11	VBACK7	PCLK	+5V	27	nWEH	D(13)	D(5)
12	nPVENd	+5V	nRESETP	28	+5V	D(14)	D(6)
13	IBIT0	GROUND	GROUND	29	LCDRW	D(15)	D(7)
14	GROUND	DIR	+5READY	30	VIN	VIN	LCDON
15	HLDA	VBACK7	+5V	31	GROUND	nBHE	nBLE
16	HOLD	BT1	nWAIT	32	NC	WRn	GROUND

Signal	Definition
+5READY	Goes high when cardiograph +5 volt supply is within regulation. Goes low when +5 volt supply is off or out of regulation.
A(1)–A(23)	CPU address bus.
ADS	CPU address strobe—active high.
BT0, BT1	Bus cycle state bits. Indicates current bus cycle.
D(0)–D(15)	CPU data bus.
DCn	CPU output. 1 = data, 0 = control cycle.
HLDA	Hold acknowledge from CPU.
HOLD	Hold request from CPU.
IBIT0, IBIT2	General purpose input bits.
INT7	Expansion interrupt.
INTR	Interrupt line to the CPU.
LCDON	Enables preview LCD.
LCDRS	Control that identifies data as display or instruction.
LCDRW	LCD read/write control—1 = read, 0 = write.
MIOn	CPU memory/IO control signal. 1 = memory cycle, 0 = I/O cycle.

nADS	CPU address strobe—active low.
nBHE	CPU byte high enable strobe.
nBLE	CPU byte low enable strobe.
nLOCK	CPU lock—active low.
nPVENd	Preview enable. Asserted low during select of preview I/O or memory.
nRD	Read enable signal for EPROM.
nRDY	Ready. Derived from wait state generator. Terminates current bus cycle.
nWAIT	Wait states are forced into the bus cycle as long as nWAIT is asserted.
nWEH	High byte write enable.
nWEL	Low byte write enable.
OBIT1	General purpose output bit.
PCLK	Phase-synchronized reference signal that indicates the CPU bus cycle phase. 0 = phase 1, 1 = phase 2.
TURBO	Changes the speed of the system clock. 1 = 32 MHz, 0 = 8 MHz.
VBACK7	Backup 5 volts for DRAM.
VIN	Rectified AC—ranges from 15 to 31 volts depending on line voltage and load.
WRn	Write/Read. CPU control bus signal. Distinguishes write cycles from read cycles.

Table A-9. Disk Power Connector J14

Pin	Signal
1	+5V
2	GROUND
3	GROUND
4	NC

Table A-10. Disk Drive Logic Connector J15

Pin	Signal	Pin	Signal
1	GROUND	18	DIRECTION
2	+5V	19	GROUND
3	GROUND	20	STEP
4	NC	21	GROUND
5	GROUND	22	WRITEDATA
6	DRV3SEL	23	GROUND
7	GROUND	24	WRITEGATE
8	INDEX	25	GROUND
9	GROUND	26	TRK00
10	DRV0SEL	27	GROUND
11	GROUND	28	WRITEPROTECT
12	DRV1SEL	29	GROUND
13	GROUND	30	READDATA
14	DRV2SEL	31	GROUND
15	GROUND	32	SIDE1SEL
16	MOTOR ON	33	GROUND
17	GROUND	34	DISKCHANGE

Signal	Definition
DIRECTION	Determines the direction of the read/write head movement.
DISKCHANGE	Indicates to the system that the disk has been removed from the drive. Goes low when the disk is removed; goes high when a disk is reloaded and a step pulse is received from the system.
DRV0SEL, DRV1SEL, DRV2SEL, DRV3SEL	Drive select signals.
INDEX	A once-per-revolution pulse that indicates the beginning of a track on the disk.
MOTOR ON	Controls the operation of the drive motor when a disk is loaded.
READDATA	Data read from the disk and sent to the system.
SIDE1SEL	Selects the side of the disk to be used.
STEP	A pulse signal that moves the heads in the direction specified by DIRECTION.
TRK00	Indicates to the system that the heads are positioned at the outermost track (track 00).
WRITEDATA	Data from the system that is written on the disk.

WRITEGATE	Enables data writing on the disk.
WRITEPRO-TECT	Indicates to the system that the disk is write protected.

Preview Display Connectors

These tables list the pin assignments for the connectors on the preview display circuit boards. J2 on the preview display logic board connects to the cardiograph's system expansion connector, J12. Its pin assignments are listed in Table A-3. The preview display is an option available only on the M1700A cardiograph.

Table A-11.
Preview Display Logic Board, J1, to Preview Display Power Supply Board, J2

Pin	Signal	Pin	Signal
1	VIN	11	UD0
2	VIN	12	UD1
3	POWERGND	13	+5VF
4	POWERGND	14	GROUND
5	LD2	15	SCP
6	LD3	16	GROUND
7	LD0	17	FP
8	LD1	18	LP
9	UD2	19	VLCDEN
10	UD3	20	GROUND

Signal	Definition
+5VF	A filtered version of the system +5V.
FP	Frame pulse. Clocks in one screen of LCD data.
LD0–LD3	Data bits for lower half of preview screen.
LP	Latch pulse. Clocks in one line of LCD data.
POWERGND	Power ground return for VIN.
SCP	Shift clock pulse. Clocks in upper and lower LCD data.
UD0–UD3	Data bits for upper half of preview screen.
VIN	15 to 31 V dc depending on line voltage and load.
VLCDEN	LCD enable signal

Table A-12. Power Supply to LCD Module, J1

Pin	Signal
1	VCFL1
2	VCFL2
3	NC
4	NC
5	VCFLRET

Signal	Definition
VCFLRET	Return path for cold fluorescent backlight power.
VCFL1, 2	Power for cold fluorescent backlights.

Table A-13. Power Supply to LCD Module, J2

Pin	Signal	Pin	Signal
1	FP	9	UD0
2	LP	10	UD1
3	SCP	11	UD2
4	NC	12	UD3
5	NC	13	LD0
6	VCCFILT	14	LD1
7	GROUND	15	LD2
8	VLCD	16	LD3

Signal	Definition
FP	Frame pulse. Clocks in one screen of LCD data.
LD0–LD3	Data bits for lower half of preview screen.
LP	Latch pulse. Clocks in one line of LCD data.
SCP	Shift clock pulse. Clocks in upper and lower LCD data.
UD0–UD3	Data bits for upper half of preview screen.
VCCFILT	Filtered +5V.
VLCD	Contrast voltage to the preview display.

B

M1754A Signal Averaged ECG (SAECG) System

Introduction

The M1754A SAECG System enables the PageWriter XLi to detect, display, and record high-frequency, low-amplitude (in the 2 to 20 microvolt range) ECG signals. The system can also detect mid-QRS micro-potentials not detected by conventional SAECG filtering techniques.

Note

The SAECG application requires the A.02.XX and higher (M1755A) software. The SAECG Patient Module also acquires standard 12 lead ECGs.

The SAECG application cannot reside on the cardiograph with the VCG application.

The SAECG software uses an XYZ lead configuration to acquire and average about 200 heartbeats. Averaging these beats allows the physician to determine whether micro-potentials exist following the QRS. These micro-potentials can indicate if the patient is at risk of sudden death from ventricular arrhythmia.

The M1754A System consists of a software disk and a high-resolution patient module. The system is easy to learn and use, and provides full signal-averaging capability while eliminating the need for dedicated SAECG equipment. The SAECG System continuously displays real-time waveforms, averaged waveforms, and noise level information on the XLi cardiograph's preview screen. The system provides three user-selectable high-pass filters (25, 40, and 80 HZ), and allows you to select either number of beats or noise level as the termination criteria. The system also allows you to adjust QRS onset and offset in all filtered leads and final vector composite, and automatically displays all QRS templates for verification. An adjustable template window lets you perform P wave averaging and HIS bundle analysis.

A patented BiSpec filter provides undistorted detection of potentials and preserves data integrity and comparability. Measurements made by the M1754A System correlate with accepted threshold criteria. The system meets or exceeds all applicable ACC/AHA recommendations for SAECG, and conforms to all applicable IEC, VDE, UL, CSA, AHA, and AAMI ECG specifications.

Installation and Configuration

Connecting the Patient Module

1. Connect the patient data cable to the ECG input jack on the back of the cardiograph.
2. Connect the other end of the patient data cable to the patient module as shown in Figure B-1.
3. Connect the leadwires to the patient module. Match the color coding on the leadwires to the color coding on the patient module.
4. Install shorting plugs in the patient module in those positions without leadwires.

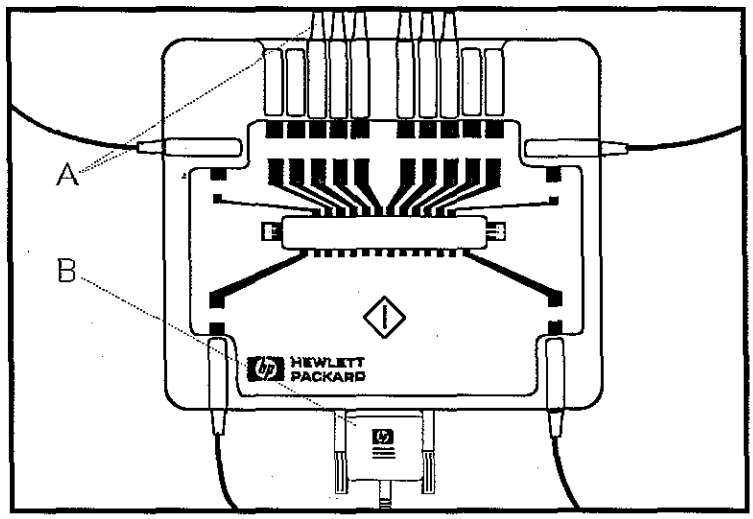


Figure B-1. Connecting the Patient Module.

A. Leadwires

B. Patient Data Cable

Note

The M1754A SAECG patient module can acquire both SAECG and standard ECGs. To get the best results for SAECG, remove the LL and LA leadwires and install shorting plugs in the LL and LA inputs.

Installing the SAECG Software

To install the M1754A SAECG application software perform the following steps.

Note

Version A.02.XX or A.03.00 software must already be installed in the cardiograph prior to installing SAECG software.

1. Press the On-Standby switch to place the cardiograph in **Standby**.
2. Insert the M1754A SAECG application disk in the cardiograph.
3. Press On-Standby to turn the cardiograph **On**. The message `Load SAECG application?` appears.
4. Press `Yes`. The copyright display appears briefly, then the following display appears:

```
******
                SAECG (M1754A - A.01.00)
```

The asterisks gradually extend across the display as the software is installed. When installation is complete, the following display appears:

```
Auto      3x4
Report    Format              01-26-92    01:23PM
```

SAECG Configuration (A.02.XX and higher Software Only)

Note

SAECG configuration can only be accessed from the SAECG application. Select `Config` from the following SAECG menu.

```
Print     Edit     Config
```

Table B-1 and Table B-2 show the configuration options for the M1754A SAECG application. The default settings appear in bold type. These defaults are adequate for most applications.

Acquisition Fields

Table B-1 shows the choices available to configure acquisition.

Table B-1. Acquisition Configuration Fields

Parameter	Setting Choices	Comments
Fiducial point?	**Left** Center Right	The peak of the QRS can be moved from the center to the right or left third of the display and the printed report. The noise window is moved by the same amount as the fiducial point.
Correlation coefficient? (0.01 - 0.99)	**0.99**	This controls how closely the acquired beats must match the template. A value of 0.99 means the acquired beats must match the template as closely as possible.
Average to?	**Noise level** Beats	The end of the averaging process is controlled by either the average noise level of the three leads, or by a total number of accepted beats.
Number of beats? (1 - 9999)[1]	**200**	The total beats that must be collected before the process completes.
Noise level? (0 - 100 μV)[2]	**0.3 μV**	The noise level required before the process completes.
Automatic file naming?	**Yes** No	This controls whether the file is named automatically. Manual file naming is used for easier file exchange with the Corazonix Predictor®.

1 This field appears only if `Beats` is selected in the `Average to?` field.

2 This field appears only if `Noise level` is selected in the `Average to?` field.

Measurement Fields

Table B-2 shows the choices available to configure measurement.

Table B-2. Measurement/Processing Configuration Fields

Parameter	*Setting Choices*	*Comments*
Filter frequency?	**40** 80 25	This sets the frequency of the high-pass filter.
Unfilt. lead scaling?	**Auto** Manual	This sets the automatic scaling of the unfiltered leads on the printed report.
Unfilt. lead scale? [1]	**100 μV/mm**	The scale used for unfiltered leads on the printed reports.
Filt. lead scaling?	**Auto** Manual	This sets the automatic scaling of the filtered leads on the printed report.
Filt. lead scale?[2]	**5 μV/mm**	The scale used for filtered leads on the printed reports.
Vector scaling?	**Auto** Manual	This sets the vector scaling on the printed report.
Vector scale?[3]	**2 μV/mm**	The vector scale used on the printed reports. Vector scaling can also be changed during editing.

1 This field appears only if `Manual` is selected in the `Unfilt. lead scaling?` field.

2 This field appears only if `Manual` is selected in the `Filt. lead scaling?` field.

3 This field appears only if `Manual` is selected in the `Vector scaling?` field.

SAECG (M1754A Only)

The SAECG application allows you to use your PageWriter XLi cardiograph to acquire signal-averaged ECGs for use in detecting late potentials. (SAECG requires A.02.XX or higher revision software, SAECG application software and an SAECG Patient Module.)

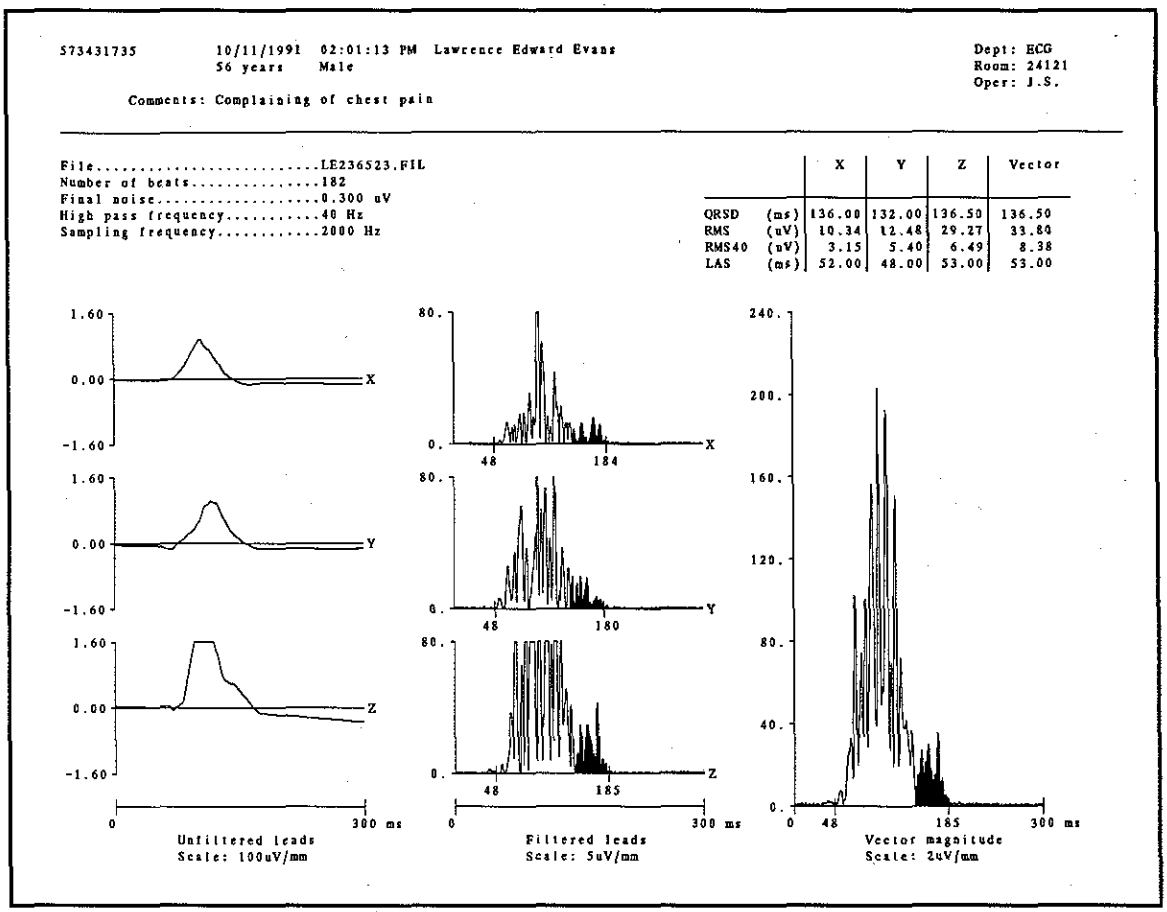


Figure B-2. An SAECG Report.

Using SAECG

To use SAECG, do the following:

1. Press (Menu) until the applications menu appears in the display:

```
                Applications
  XLi       Prev+     SAECG
```

Note

If the applications menu does not appear, press (Menu) until the following appears in the display:

```
                        Prev+
 Reformat    Timed   ContPrev    Delayed      Exit
```

Press Exit to display the applications menu.

2. Press SAECG. A display similar to the following appears:

```
                    SAECG
 Start                              02/13/92   10:22AM
```

3. Press Start. The message `Determining template beat ...` appears, followed by this display:

```
              Select the template.
 Select    Reject    Match      Noise       Exit
```

In addition, the template beat with the matching and noise windows appears on the preview screen as shown in Figure B-3.

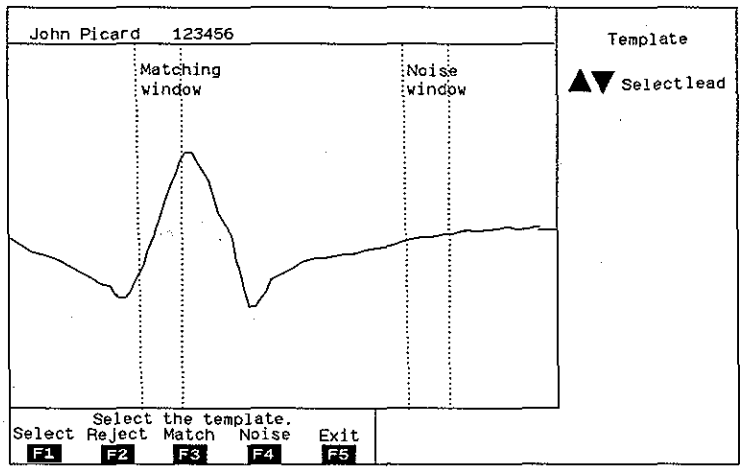


Figure B-3. A Template Screen.

`Select` — Confirms the displayed template beat. (The template beat is a typical beat used to match other beats during averaging.) You must do this before you can start the SAECG process.

`Reject` — Rejects the displayed template beat and acquires another.

`Match` — Lets you adjust the matching window. Use the ◀ and ▶ keys to position the window, then press `Done`. Make sure the matching window contains the fastest rising portion of the R wave.

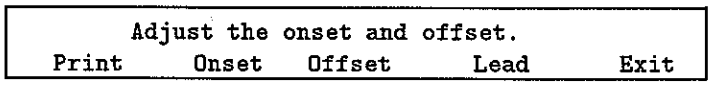
`Noise` — Lets you adjust the noise window. Use the ◀ and ▶ keys to position the window, then press `Done`. Make sure the noise window is on a flat part of the signal, and that the T wave is not inside the window.

▲ and ▼ — Allow you to place the template on another lead.

4. Once you have selected a template beat, the message `Averaging ...` appears, and the preview screen displays continuous ECG signals for leads X, Y, and Z.

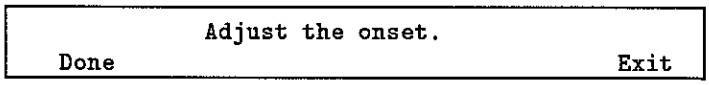
Note — You can press `Done` at any time to end the averaging process.

5. When the averaging process is complete, the message `Filtering averaged beats ...` appears, followed by this display:



`Print` Prints and stores the SAECG report. If your application is configured for manual file naming, you will be prompted to name the file after it prints. The name can have up to eight characters followed by a three-digit extension; for example, MKEATING.001. Press `Done` to store the report.

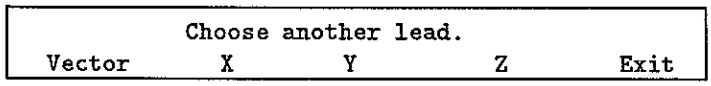
`Onset` Allows you to adjust the QRS onset marker. When you press `Onset` or `Offset`, the following display appears:



Use the ◀ and ▶ keys to move the onset window, then press `Done`.

`Offset` Allows you to adjust the QRS offset marker (see above).

`Lead` Lets you view another lead. When you press `Lead`, the following display appears:

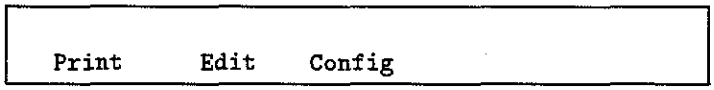


Press `X`, `Y`, or `Z` to view that lead, or press `Vector` to view the combined vector lead. You can adjust the onset and offset for each lead independently and for the combined vector lead.

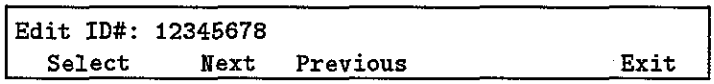
Editing and Printing a Stored SAECG

To edit or print a stored SAECG report:

1. Press (Menu) until the following display appears:



2. Press Edit. A display similar to the following appears:



3. Press Next or Previous until the patient ID number you want appears.
4. Press Select. The onset/offset adjust menu shown earlier appears.

Note

If you know the patient ID number of the ECG you want to edit or print, you can select the ECG as follows:

- Press More, then Find.
- Type the patient ID number. Press Enter. The most recent ECG with that patient ID number appears.
- If you want a different ECG for that patient, you must scroll through the list by pressing Previous.
- When the ID number you want appears, press Select.

You can now adjust the onset and offset and print the report as described earlier.

Deleting a Stored SAECG

You can delete SAECGs from the main XLi menu by selecting the SAECGs to be deleted and pressing Delete.

Performance Verification and Maintenance

Extended Self-test

The cardiograph's Extended Self-test, loaded as part of the system software, tests each major subassembly. The display tests and the printer test require visual verification of displayed or printed output.

In most cases, a test failure halts the test and a message indicating the failure appears on the keyboard display. In the case of the tests that require visual verification, visible failure symptoms appear in the printed or displayed test pattern. See the "Troubleshooting," section for a list of self-test failure messages and failure symptoms.

To begin the Extended Self-test, press (On-Standby) to turn on the cardiograph, then quickly press and release the (Alt) and (x) keys simultaneously. The following display will appear:

```
Test: All
  Select     Test      Next     Previous  ErrorLog
```

The upper line displays the test choice, while the lower line displays the softkey labels. With the softkeys you step through the test menu, select tests, and initiate testing.

`Select`	Selects the test displayed in the message line. Asterisks (*) appear around the test name to indicate its selection. If the test is already selected, pressing this key de-selects the test (the asterisks disappear). You can select one or more tests in any combination, but the sequence is fixed.
`Test`	Begins running the selected test(s).
`Next`	Steps forward through the test menu.
`Previous`	Steps backward through the test menu.
`ErrorLog`	Prints out the stored error log.

To stop or exit Extended Self-test, you must press (On-Standby) to place the cardiograph in **Standby**.

These are the tests available in Extended Self-test:

- Patient module and cable
- CPU assembly
- Printer
- Disk drive (M1700A and M1701A only)
- Preview display (M1700A only)
- Keyboard display
- Modem and cable (M1700A only)
- All

The patient module and cable test is described in more detail in the discussions that follow.

Patient Module and Cable Test

This test looks for failures in the patient module and patient data cable, and generates a test pattern in the patient module display.

If the patient module fails the test, the message `Patient module test failed.` appears on the keyboard display. If the cable fails the test, the message `Patient module cable test failed.` appears.

Note

The patient module test does not test the patient electrodes or leadwires. Test the patient electrodes and leadwires by recording an ECG from a patient or ECG simulator as described later in this section.

The test patterns displayed on the patient module consist of (in this order):

- all white cells
- checkerboard cells
- all black cells
- inverse checkerboard cells
- 80 characters (displayed in 5 successive groups of 16)
- all white cells

You must observe the patient module display while the test pattern is running to ensure:

- accurate rendition of all patterns and characters
- no random lines or dots are displayed

Before and after the tests, asterisks appear in the display.

Theory of Operation

The SAECG Patient Module

In standard mode, the SAECG patient module operates as described in "The Standard Patient Module," to acquire "classical" ECGs. In SAECG mode, the SAECG patient module operates as in standard mode except for the following:

- The module collects data from 6 electrodes.
- The multiplexors sample the data twice in each sampling period, giving a functional sample rate of 8 kHz instead of 4 kHz.
- SAECG mode increases amplifier gain and analog-to-digital conversion resolution by a factor of approximately 4.1. This provides better signal resolution and reduces system noise.

You can use SAECG mode with all four limbwires (RA, LA, RL, LL) attached. However, you will get better results if you attach only RA and RL, and insert shorting plugs in LA and LL. This is because the common mode rejection performance is enhanced if the LL and LA inputs have shorting plugs installed. The SAECG software does not include line frequency rejection; since the signals of interest are smaller than in standard mode, common mode rejection becomes critical.

Figure B-4 shows a block diagram of the SAECG patient module's circuitry.

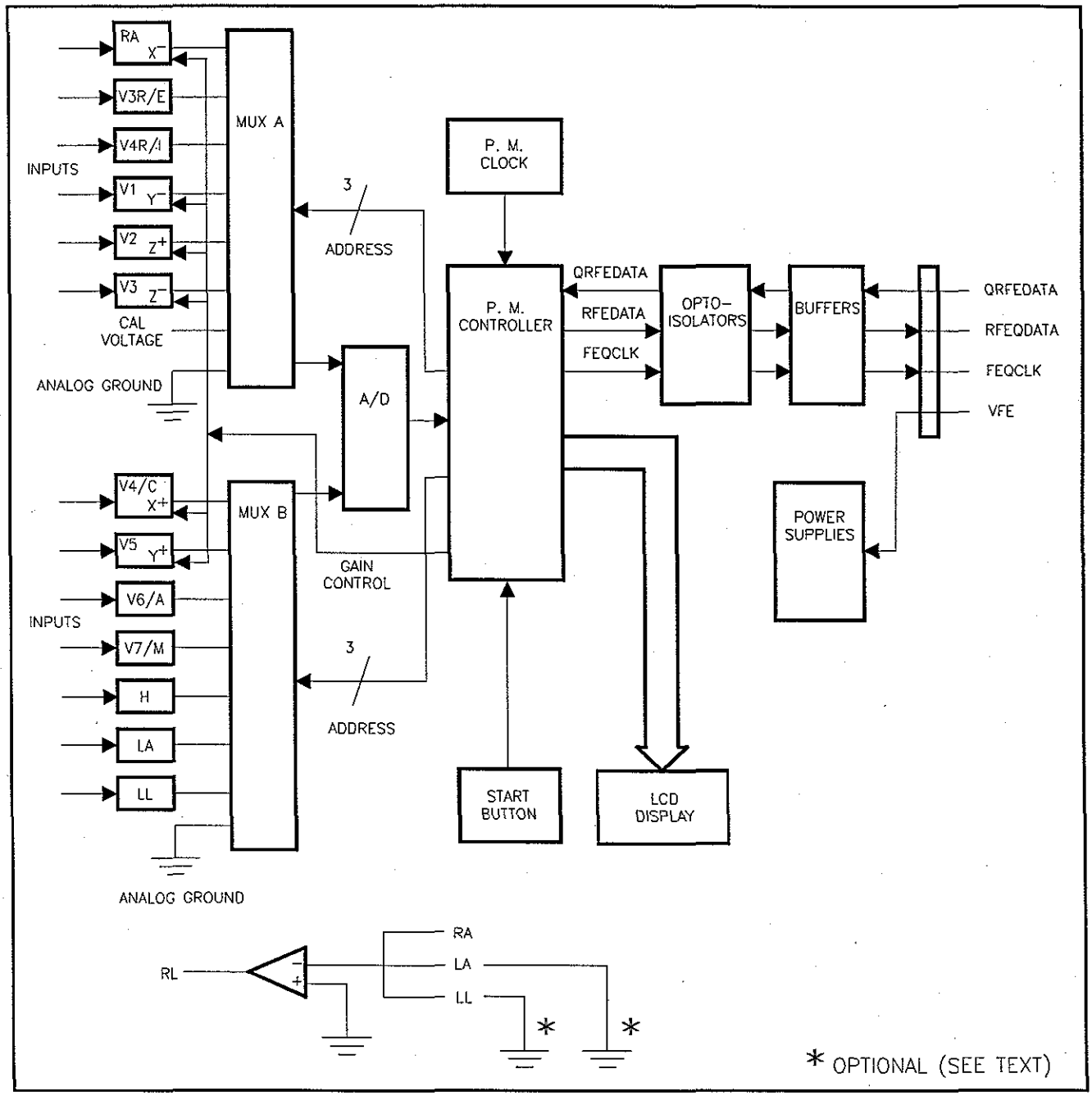


Figure B-4. SAECG Patient Module Block Diagram.

Table B-3. SAECG Testing Problems

Symptom	What to Do
Message: `6503` appears.	The XLi cardiograph software has not yet been installed. Install the XLi software before installing the SAECG software.
Message: `No room to load application.` appears.	Delete another application such as Preview Plus, before installing the SAECG application.
Message: `Attach SAECG patient module.` appears.	Attach the SAECG patient module before attempting to use the SAECG application.
Message: `No heartbeat. Check connections.` appears.	A lead might not be connected. Refer to Chapter 1 for information on how to apply electrodes for an SAECG.
The noise stops decreasing during averaging.	A lead might be off. Check the leads and continue or restart the SAECG test.
The application does not average to the preset level of noise.	The ECG signal is too noisy.

Table B-4. Patient Module and Patient Data Cable

Symptom	Cause	Corrective Action
Noisy lead X.	Poor electrode contact (X^- or X^+).	Refer to *M1754A SAECG User's Manual*.
	X^- or X^+ leadwire defective.	Replace leadwire.
Noisy lead Y.	Poor electrode contact (Y^- or Y^+).	Refer to *M1754A SAECG User's Manual*.
	Y^- or Y^+ leadwire defective.	Replace leadwire.
Noisy lead Z.	Poor electrode contact (Z^- or Z^+).	Refer to *M1754A SAECG User's Manual*.
	Z^- or Z^+ leadwire defective.	Replace leadwire.
No SAECG waveforms.	LA or LL not terminated.	Install shorting plugs or connect LA and LL to patient.

Parts List

Table B-5. SAECG Parts List

Description	Part No.
SAECG patient module, AHA (M1700A)	M1700-69511
SAECG patient module, IEC (M1700A)	M1700-69512
Patient data cable, 2.5 M	M1719A
Patient data cable, 9.0 M	M1720A
Label for SAECG patient module, AHA (M1700A)	M1700-84589
Label for SAECG patient module, IEC (M1700A)	M1700-84590
Module end label	M1700-84521
Software set, SAECG, version A.01.00 (M1754A)	M1754-17700

M1756A Direct Digital ECG Fax

Introduction

The M1756A option lets the XLi transmit high-quality ECGs to any CCITT Group 3 fax machine, or to any XLi equipped with direct digital fax. The M1756A also enables the XLi to receive fax transmissions from any Group 3 fax machine. Fax capability is ideal for transmitting ECGs to sites that do not have a cardiograph or ECG management system.

Note

Fax modem transmission requires the A.02.XX and higher (M1755A) software. The FAX Modem also functions in place of the M1706A Hayes Modem for standard ECG transmissions.

Typical fax machines send ECGs by optically scanning a paper copy of the ECG. This often produces low-quality faxes not always adequate for making diagnoses. In contrast, the M1756A transmits the electronic ECG directly from the XLi, without scanning a paper copy. This produces faxes of exceptional quality.

The M1756A fax option can be used by service personnel to receive faxed support information directly on the XLi.

The M1756A option consists of a Worldport 2496^{TM} Fax/Data modem and a software disk. A 9-volt battery allows up to 3 hours of transmission while the XLi is on battery power. The fax modem can also be powered from the cardiograph.

Installation and Configuration

The following table lists the settings to choose to configure the system to use a fax modem.

Note

Each site may have different requirements. Only ECGs may be faxed. SAECGs and VCGs may not be faxed.

Parameter	Choice
Connection?	FAX Programmable Modem
Baud Rate?	2400
Phone #?	Type phone number, 36 characters max.
Dial Type?	**Tone**
	Pulse
Pause Length?	**2**, 4, 6, 8, 10 (secs)
Destination?	Type name, 22 characters maximum.
Print grid on report?	Yes, No (A.03.XX only)

Operation

The fax modem allows you to send and receive ECGs using standard fax machines. The cardiograph must be configured for these functions before you can use them. (See chapter 2 for information about configuring your cardiograph for transmitting ECGs.) Fax transmission also requires A.02.XX revision software.

Transmitting ECGs by Fax

After the cardiograph has been configured to use a site for fax transmission, you can fax an ECG to the site. To transmit an ECG:

1. Press (Menu) until the following display appears.

```
Transmit Store    Config  CheckDisk Files
```

2. Press `Transmit`. The following display appears.

```
                Transmit
Selected   All   NewGroup   Query    Exit
```

3. Press `Selected`. The message `Reading the disk` appears, followed by this display:

```
123456                      02-13-92   12:09:41PM
Select   Transmit Next   Previous   More
```

4. Press `Next` or `Previous` until the patient ID number you want appears, then press `Select`.

Note

If you know the patient ID number of the ECG you want to transmit, you can select the ECG as follows:

- Press `More`, then `Find`.
- Type the ID number and press `Enter`. The most recent ECG with that ID number appears.
- If you want a different ECG for that patient, scroll through the list by pressing `Previous`.
- When the ID number you want appears, press `Select`.

5. Press `Transmit`. The following display appears:

```
              Choose site
1       2       3       4       Manual
```

6. Press the key under the number of the intended receiving site. This number corresponds to the receiving site previously

configured. Messages such as `Calling site`, `Connected to site`, `Transmitting ...` , and `Transmitting 1 of 1 ECG(s)` might appear.

7. When the ECG has been successfully transmitted, the message `1 ECG(s) Transmitted` appears.
8. Press `Exit` to continue.

Transmitting More than One ECG

- To transmit several ECGs, follow the same steps as above, but select all the ECGs you want to transmit. After selecting the ECGs, press `Transmit`.
- To transmit all stored ECGs, follow the same steps as above, but press `Transmit` `All` instead of `Transmit` `Selected`.
- To transmit all ECGs that have not been previously transmitted, follow the same steps as above, but press `Transmit` `NewGroup` instead of `Transmit` `Selected`.
- `Manual` allows you to transmit to a site that has not been configured.

Note

See the *PageWriter XLi User's Reference Guide* for more information about transmitting ECGs.

Receiving ECGs

The cardiograph can receive ECGs from a fax machine whenever it is turned on, configured for fax modem usage, and idle. If the cardiograph is turned off, it cannot receive ECGs. All ECGs are printed as they are received. You cannot edit or store received ECGs.

You can stop receiving the ECGs any time by pressing Stop.

Note

The fax modem can also transmit ECGs to receivers other than fax machines. When configured as a programmable modem, the fax modem performs in the same manner as the M1706A Hayes® modem.

548-

Performance Verification and Maintenance

Extended Self-test

The cardiograph's Extended Self-test, loaded as part of the system software, tests each major subassembly. The display tests and the printer test require visual verification of displayed or printed output.

In most cases, a test failure halts the test and a message indicating the failure appears on the keyboard display. In the case of the tests that require visual verification, visible failure symptoms appear in the printed or displayed test pattern. See Chapter 6, "Troubleshooting," for a list of self-test failure messages and failure symptoms.

To begin the Extended Self-test, press (On-Standby) to turn on the cardiograph, then quickly press and release the (Alt) and (x) keys simultaneously. The following display will appear:

```
Test: All
  Select     Test      Next     Previous  ErrorLog
```

The upper line displays the test choice, while the lower line displays the softkey labels. With the softkeys you step through the test menu, select tests, and initiate testing.

`Select`	Selects the test displayed in the message line. Asterisks (*) appear around the test name to indicate its selection. If the test is already selected, pressing this key de-selects the test (the asterisks disappear). You can select one or more tests in any combination, but the sequence is fixed.
`Test`	Begins running the selected test(s).
`Next`	Steps forward through the test menu.
`Previous`	Steps backward through the test menu.
`ErrorLog`	Prints out the stored error log.

To stop or exit Extended Self-test, you must press (On-Standby) to place the cardiograph in **Standby**.

These are the tests available in Extended Self-test:

- Patient module and cable
- CPU assembly
- Printer
- Disk drive (M1700A and M1701A only)
- Preview display (M1700A only)
- Keyboard display
- Modem and cable (M1700A only)
- All

The modem and cable test are described in more detail in the discussions that follow.

Fax Modem Test (M1700A Only)

The modem test checks the operation of the Worldport 2496™ fax modem.

Note

The fax modem may have a 9 V battery installed. If a battery is not installed, the cardiograph should be connected to AC voltage to test the fax modem.

If the fax modem passes the test, the message `Modem firmware checksum: xxx.` appears. If the modem fails the test, the message `Modem test failed.` appears on the keyboard display.

Note

If the M1700A is not equipped with a modem, selecting the modem test results in a test failure. If you have selected the "All" test choice, remove the modem test from the selected tests to avoid an erroneous test failure.

Table C-1. Transmit and Fax

Symptom	Cause	Corrective Action
Message: `No answer at site.`	Cabling problems between fax modem and cardiograph.	Perform Extended Self-test modem test.
	Telephone line or telephone cable defective.	Substitute normal telephone for fax modem and dial number. Ensure that fax answers with high-pitched tone.
Extended Self-test modem test failure	RS-232 cable not plugged in or defective.	Plug in to cardiograph; if defective, replace.
	Power cable not plugged in or defective, or cardiograph AC off.	Plug in to cardiograph and turn on AC; if defective, replace.
	Fax modem not turned on.	Turn on Fax modem. Check for unplugged or defective power cable.
	Fax modem battery bad.	Replace battery.
	Defective fax modem.	Replace fax modem.
	Defective CPU assembly.	Replace CPU assembly.
Unable to transmit or receive. Modem passes Extended Self-test.	Phone cable unplugged or defective.	Plug in phone cable; if defective, replace.
	Configuration changed without cycling power.	Cycle power on cardiograph.
	Defective fax modem.	Replace fax modem.
	Defective CPU assembly.	Replace CPU assembly.
	9V power missing.	Check voltage at cardiograph power connector.
	ECG disk is write-protected.	Move write-protector tab.
Black or white lines appear on the fax.	Noisy phone lines lose fax data.	Call again, if possible on another phone line.

Note

The fax modem does not require a battery for operation when the cardiograph is connected to AC power. However, the fax modem cannot receive when operating from the battery.

Parts List

Table C-2. Fax Modem Parts List

Description	Part No.
Screw, 10-32, knurled for fax modem	0370-3219
Fax modem (Canada)	M1756-89502
Fax modem (France)	M1756-89503
Fax modem (Italy)	M1756-89506
Fax modem (Netherlands)	M1756-89504
Fax modem (United Kingdom)	M1756-89505
Fax modem (United States)	M1756-89501
Fax modem bracket	M1756-07300
Standard fax modem cable	M1756-61600

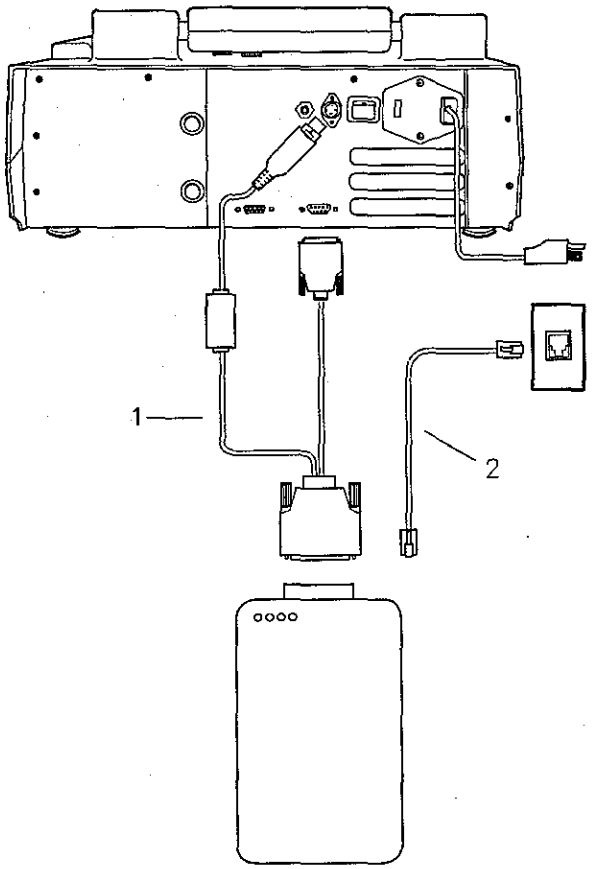


Figure C-1. Cabling for FAX Modem Transmission Only

Table C-3. Fax Modem Cable Parts List

Ref No.	Description	Part No.
1	FAX Modem Cable	M1756-61600
2	Phone Line Cable	See table 8-11

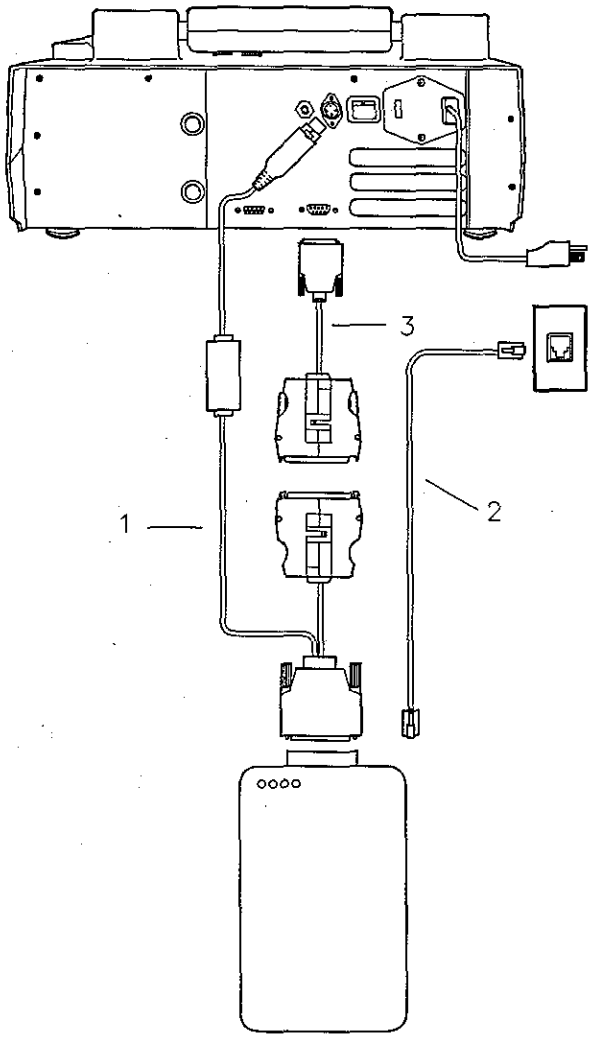


Figure C-2.
Cabling for FAX Modem and Direct Connect (Quick Connect) Transmission

Table C-4.
Fax Modem and Quick Connect Cable Parts List

Ref No.	Description	Part No.
1	FAX Quick Connect Cable	M1756-61601
2	Phone Line Cable	See table 8-11
3	Quick Connect Cable	M1706-61636

Note

The M1706-61636 cable functions as a direct connect cable when separated from M1756-61601

D

Vectorcardiography M1790A

Introduction

Note

The VCG application requires the A.03.XX software. The VCG application cannot reside on the cardiograph with the SAECG application.

The M1790A VCG system adds vector loops reporting capability to the PageWriter XLi cardiograph. The Vectorcardiogram (VCG) is a recording of the changes in spatial orientation, direction and magnitude of the electrical activity of the heart. The VCG application requires the use of three orthogonal leads (X, Y, Z). The PageWriter XLi cardiograph's patient module can be set up to use Frank leads which provide the X, Y, and Z leads.

If the X,Y,Z leads were connected when the ECG was acquired and one of the VCG report formats was configured, a one page VCG report will be printed immediately after the ECG report any time an ECG is printed on the cardiograph. One of the following Auto ECG report formats must be selected in order to record a VCG:

- 3x4,1R configured with an X,Y or Z rhythm strip
- 3x4,3R configured with X,Y,Z rhythm strips

Note

The M1730A TraceMaster ECG Management System does not print a VCG, although you can store VCG data to the system from a disk.

Research has shown that VCGs offer incremental diagnostic value over conventional 12-lead ECGs in the areas of atrial enlargement, right ventricular hypertrophy, and in the recognition of certain infarctions.

Installation and Configuration

VCG recording requires that you use the Frank lead set in addition to the standard 12-lead set to obtain the VCG from the patient. The following information describes how to set up the patient module and attach leads to the patient for VCG recording.

Setting Up the Patient Module

To set up the patient module, perform the following steps.

1. Turn off the cardiograph.
2. Replace the four shorting plugs on the patient module with Frank lead wires I, E, M, H. Optionally, you may replace V4 (C4) and V6 (C6) chest lead wires with Frank lead wires C and A.
3. Turn on the cardiograph.

The following tables describe how to set up the patient module for the lead set you are using.

Table D-1.
AHA Lead Set and Patient Module Configurations

Lead	Lead Color Code	Label Color	Slot Label
I	Orange/Red	Red	V4R
E	Orange/Yellow	Yellow	V3R
C	Orange/Green	Blue	V4
A	Orange/Brown	Violet	V6
M	Orange/Black	Black	V7
H	Orange/Violet	Violet	H

Table D-2. IEC Lead Set and Patient Module

Lead	Lead Color Code	Label Color	Slot Label
I	Light Blue/Red	Grey	C4R
E	Light Blue/Yellow	Pink	C3R
C	Light Blue/Green	Brown	C4
A	Light Blue/Brown	Violet	C6
M	Light Blue/Black	Orange	C7
H	Light Blue/Violet	Violet	H

Software Installation

Note

Version A.03.1X software must be installed in the cardiograph prior to installing VCG software.

To install the M1790A VCG software, perform the following steps.

1. Press (On-Standby) to place the cardiograph in Standby.
2. Insert the application disk, labeled "VCG Disk," in the disk drive in the front of the cardiograph.
3. Turn on the cardiograph. The message `Load VCG Application?` will appear.
4. Press `Yes`. When installation is complete, the following display appears:

```
Auto      3x4
Report    Format              01-26-92    01:23PM
```

VCG Configuration (A.03.XX Software Only)

To configure the PageWriter XLi cardiograph for VCG recording, perform the following steps.

1. Press (Menu) twice until the following display appears.

```
Transmit Store    Config  CheckDisk Files
```

2. Press `Config`. The main configuration menu will appear.

```
                Configuration
Global      ID      Transmit    Files     Exit
```

3. Press `Global` for global configuration selections.
4. Select the VCG choices as shown in Table D-3.
5. Press `Exit` twice when you have finished configuring your cardiograph.

Table D-3 lists global configuration parameters and choices you need for VCG recording.

Table D-3. Global Configuration Fields

Parameter	VCG Setting Choices	Comments
Special applications?	Yes	
Research leads?	No	Select "No" to enable Frank leads.
ECG storage mode?	Standard (250 samples/second) Special (500 samples/second)	Special is the preferred mode for VCG storage.
VCG?	Off VCG1 (0° to 360°, right sagittal) VCG2 (0° to 360°, left sagittal) VCG3 (-180° to +180°, right sagittal) VCG4 (-180° to +180°, left sagittal)	Select "Off" to suppress the VCG report.

Disabling VCG Reports

To reconfigure the cardiograph to disable VCG reports, select "Off" in the VCG? parameter of global configuration. Now, you cannot record VCGs until the cardiograph is reconfigured for VCG recording and the Frank lead set is attached.

Operation

You must configure the cardiograph for VCG recording and have Frank leads attached to the patient in order to record a VCG.

Recording a VCG

To record a VCG, perform the following steps.

1. Press (Stop)
2. To select Auto report, press Report until Auto appears above Report.
3. Press Format to select the 12-lead Auto ECG report format. Select one of the two rhythm formats: 3 x 4, 1R or 3 x 4, 3R.
4. Press Leads to select which leads are recorded for the rhythm strips. Select X, Y, or Z for the rhythm strip lead with the 3 x 4, 1R format and select X, Y, Z for the rhythm strip leads with the 3 x 4, 3R format. The VCG format representation that is currently configured will be displayed in parentheses next to the ECG format. Refer to the *VCG Report Formats* section later in this chapter for information about VCG report formats.
5. Press (Auto). The VCG report will be printed after the ECG Auto report is printed.
6. Press (Copy) for additional copies.

Printing a Stored VCG

Print a stored VCG the same way you print a stored ECG. Select a file that has been accquired with Frank leads and press Print. Both the Auto ECG report and the VCG report will be printed.

Preventing the VCG Report from Printing

To prevent the one-page VCG report from printing when the patient is connected to Frank leads, select a report format that is not one of the following formats:

3 x 4, 1R X
3 x 4, 1R Y
3 x 4, 1R Z
3 x 4, 3R XYZ.

The VCG Report

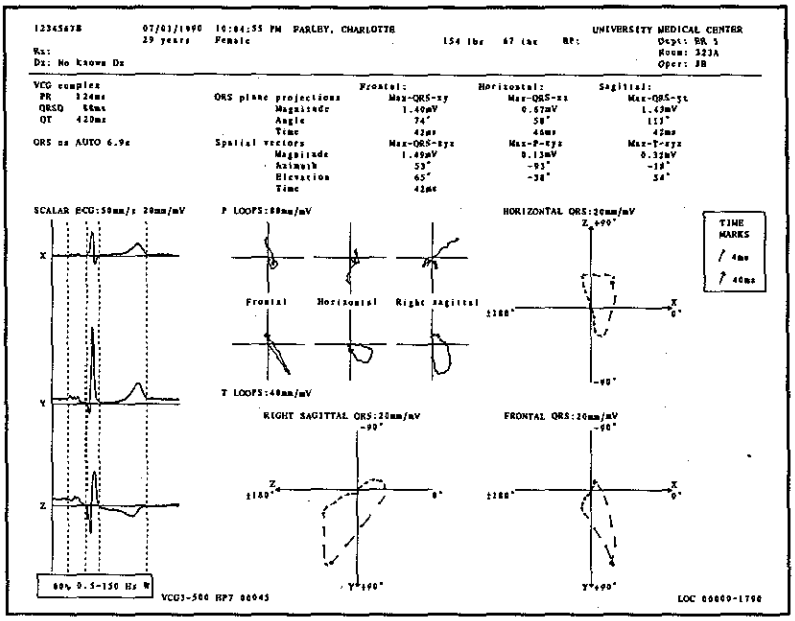


Figure D-1. The VCG Report

VCG Report Formats

Formats

The VCG formats correspond to the layout of the frontal, horizontal, and sagittal QRS loops and the angular scales used for the axes. There are four different VCG report formats: VCG1, VCG2, VCG3, and VCG4. Each report format shows a different relative position of QRS loops within the loop representation area and uses a different angular scale.

Table D-4. VCG Report Formats

Format	Sagittal Projection	Angular Scale
VCG1	Right sagittal	0° to 360°
VCG2	Left sagittal	0° to 360°
VCG3[1]	Right sagittal	-180° to +180°
VCG4[1]	Left sagittal	-180° to +180°

[1]Format conforms to the recommendations of the AHA.

The horizontal plane is always viewed from the head rather than the foot and the frontal plane is viewed from the chest and not the back. But, the sagittal plane is not standardized and can be viewed from either the left or the right side. Therefore, we support both the left and right sagittal projections in each of the two types of reports.

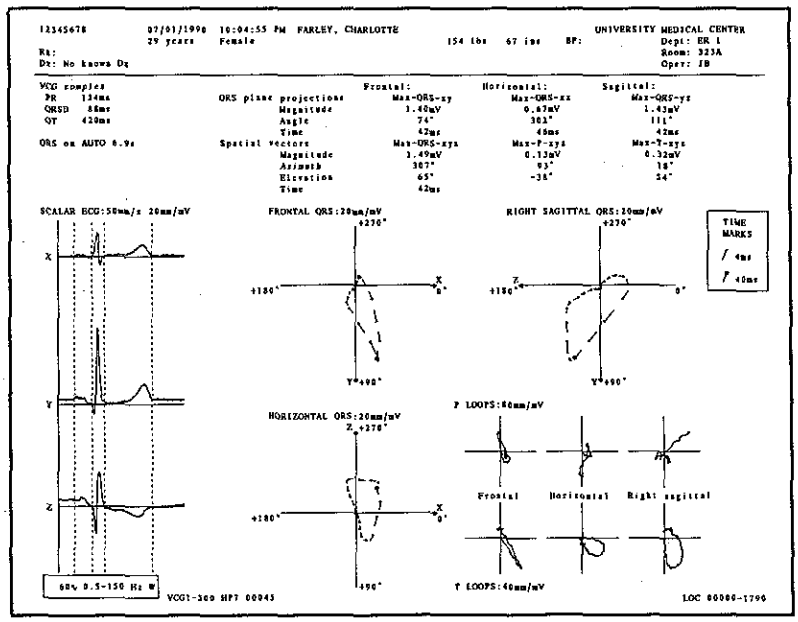


Figure D-2. VCG1: Right Sagittal, 0° to 360°.

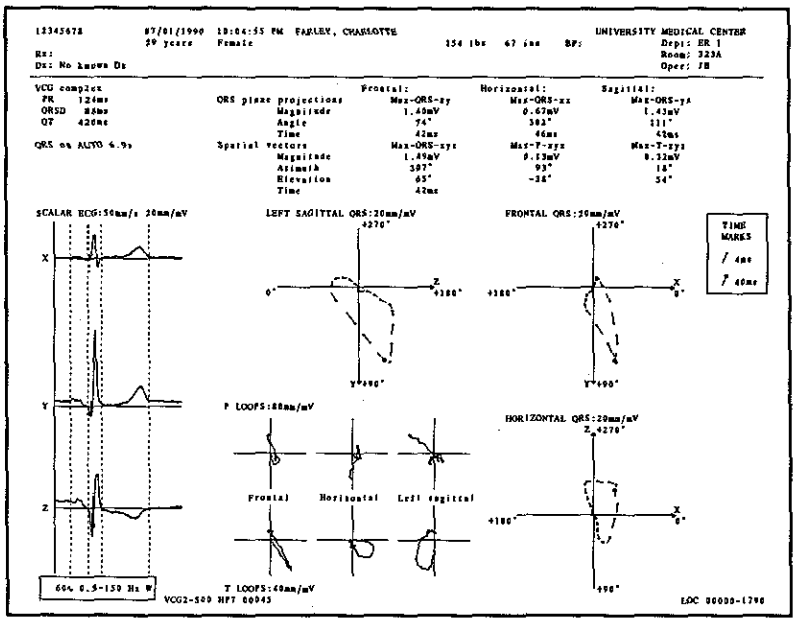


Figure D-3. VCG2: Left Sagittal, 0° to 360°.

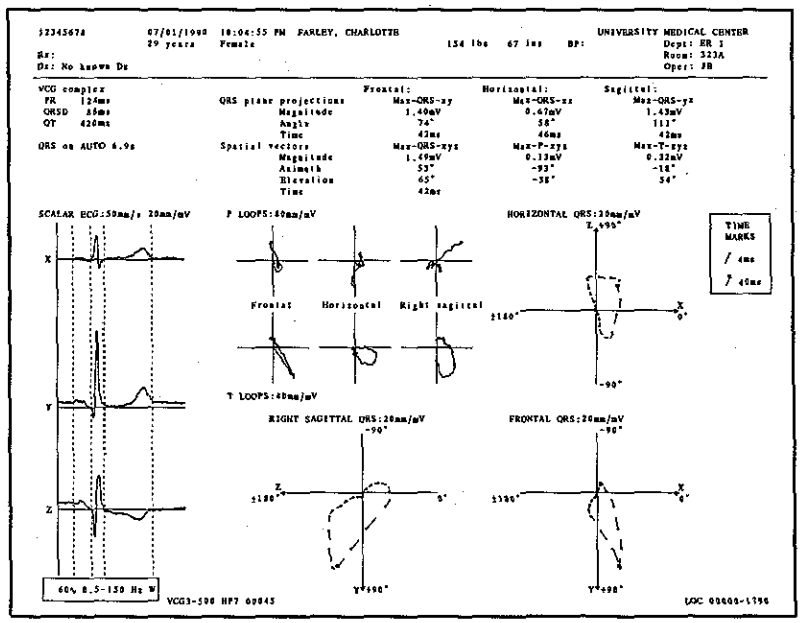


Figure D-4. VCG3: Right Sagittal, -180° to +180°.

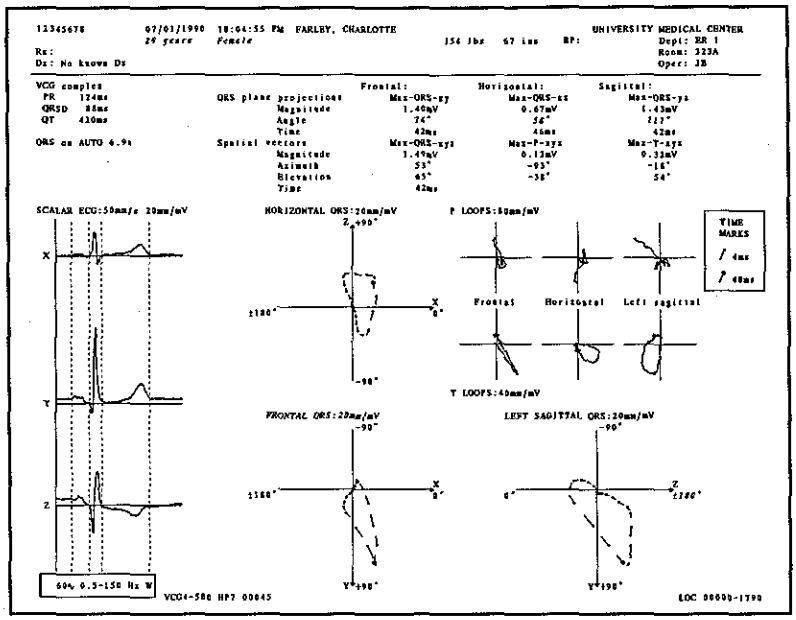


Figure D-5. VCG4: Left Sagittal, -180° to +180°.

Manual Report Formats

When the cardiograph is configured for VCG recording, some manual report formats with Frank leads are automatically added to the list of formats from which you can choose. One of the manual 3-lead ECG report formats contains the X, Y, and Z leads. Another format is the custom 3-lead group, which can be set in the global cardiograph configuration to include any combination of three out of 15 leads.

Caution

If you configure a custom 3-lead group, you must choose the X, Y, and Z leads in that sequence to be able to print a VCG report from that format. The VCG report cannot be printed unless the leads are presented in the correct sequence.

Troubleshooting

This chapter contains information about troubleshooting the VCG recording.

Table D-5. Troubleshooting

Symptom	Cause	What to do ...
Extra lead labels VX1, VX2, VX3, VX4 appear in the cardiograph's display	Research leads instead of Frank leads are configured	In global configuration, under "Special applications", change the answer to the **Research leads?** question to "No" to enable Frank leads. Turn the cardiograph off and on again.
Extra lead labels V3R, V4R, and V7 instead of X, Y, and Z appear on the cardiograph's display	The Frank lead wires are not correctly plugged into the patient module. The H slot contains a shorting plug.	Be sure that all Frank lead wires are correctly plugged in. Be sure that all of the other leads are plugged into the patient module and that no shorting plugs are installed. Turn the cardiograph off and on again.

Table D-5. Troubleshooting (continued)

Symptom	Cause	What to do ...
No VCG report is printed and the message `Defective VCG data` appears briefly on the cardiograph's display. The Electrode off message appears on the Auto ECG report.	One or more X, Y, Z leads are missing or the ECG line is flat.	Be sure that all Frank lead wires are correctly plugged into the patient module.
No VCG report is printed after the 12-lead Auto ECG report.	Incorrect 12-lead Auto ECG report format selected	Select either a 3 x 4, 1R format with an X, Y, or Z lead as rhythm strip or select a 3 x 4, 3R format with X, Y, and Z leads as rhythm strips.
	VCG report format not selected to enable VCG printing.	In global configuration, change the answer to the `VCG?` question to one of the four possible VCG report formats: VCG1, VCG2, VCG3, or VCG4.
No VCG report is printed from the stored VCG file.	A VCG format was not selected to enable VCG printing	In global configuration, change the answer to the `VCG?` question to one of the four possible VCG report formats: VCG1, VCG2, VCG3, or VCG4.
	No X, Y, or Z lead ECG data has been recorded.	VCG report printing is impossible.
	X, Y, Z data was recorded in special mode (500 samples/second) on a cardiograph not configured for VCG recording.	Analyze the ECG on a cardiograph that is configured for VCG recording.

Parts List

Table D-6. VCG Parts List

Description	Part No.
Software set, VCG, version A.01.00 (M1790A)	M1790-17700
Leadwire set, Peds/Frank (includes 2 Frank leads labels	M1717B
Shorting plug	M1700-47602

Index

1

1 ECG(s) Transmitted, C-3

5

+5 backup supply, 5-21
+5 overvoltage/undervoltage circuit, 5-19
+5READY signal, 5-19, 5-26, A-8
+5-to-backup switchover circuit, 5-21
+5V, 6-23, A-3, A-8, A-9, A-10
+5VF, A-11
+5 volt regulator, 5-2, 5-19
5VREF, A-3

A

A(1)–A(23) signals, A-8
AC
  power, 2-2
  switch, 2-2
accessories, cardiograph, 1-10–11
AC indicator, 2-13, 3-3, 5-20, 7-4
AC on detector circuit, 5-20
ACONLED signal, 5-20, A-2
ACON signal, 5-20
address bus, 5-8
ADS signal, A-8
AHA leads, D-2
Alt, 3-3
alternate main menu, 3-9
analog-to-digital converter, 5-1, 5-6, B-13
angular scale, D-7
Applications display, B-3
arrow keys ◀ ▶ ▲ ▼, 3-3
AutoCopy parameter, 2-25
AutoDial
  configuration, 2-30
  site selection, 2-30
Auto report
  formats, 3-4
  rhythm lead selection, 3-4
Auto,start control, 3-3

B

backup +5 supply, 5-21
battery
  compartment, 2-11
  holder, 2-11
  installation, **2-11**
  operation, 5-18
  problems, 6-9
  removing, 7-2
  replacing, 2-11, 7-4
  slot, 2-12, 7-4
  temperature, 5-18
  timeout, configuring, 2-26
battery charger, 5-18
  converter, 5-18
  current limiting, 5-18
  cycle output mode, 5-18
  float output mode, 5-18
battery condition, 5-18
  low battery disconnect, 5-19
  low battery shutdown, 5-18
  low battery warning, 5-18
battery connector, 5-18
battery level indicator, 2-13, 3-3, 5-20, 7-4
battery sensor, 5-18
battery switch circuit, 5-20
battery-to-AC switchover circuit, 5-20
baud rate, 2-7
baud rate selection
  receive, 2-30
  transmit, 2-28
block diagram
  CPU assembly, 5-9
  digital signal processor, 5-15
  disk drive, 5-15
  I/O control, 5-13
  patient module, 5-7
  power supply, 5-17
  preview display, 5-24
  preview display power supply, 5-27
  preview logic board, 5-25
  printer, 5-23
  SAECG patient module, B-14
  serial communications circuit, 5-14
  system, 5-5
  system memory, 5-11
brightness knob
  preview screen, 3-3, 5-27
BT0, BT1 signals, A-8

C

cable
  modem, 2-2
  printer, 2-4
cable options, 1-9
cables
  fax modem, connecting, 2-3
calibration pulse
  amplitude, 4-9
  duration, 4-9
calibration voltage, 5-6, B-13
Calling site, C-3
cardiograph
  cleaning, 4-10
  configuring, 2-17
  CPU initialization, 5-3
  description, 1-1
  installing on cart, 2-2
  model differences, 1-2
  operation, 3-1–16
  operational overview, 5-1
  options and accessories, 1-9–11
  password, 2-17
  specifications, 1-5
cardiograph specifications, 1-8
cart, 1-3
  description, 1-3
  parts list, 8-20
changing
  the date setting, 2-16
  the line fuses, 2-10
  the line voltage setting, 2-8
  the time setting, 2-16
CHARGEROFF signal, 5-20
CheckDisk, 3-11
Choose site, C-3
choosing
  a report format, 3-4
  language, 2-13
  the line frequency, 2-13
circuit descriptions, 5-4–27
cleaning, 4-10–13
  cardiograph, 4-10
  electrodes, 4-13
  keyboard, 4-10
  leadwires, 4-13
  paper sensor, 4-11
  patient data cable, 4-13
  printhead, 4-11
cleaning materials, 4-10, 4-11
configuration, 2-17–32
  AutoDial, 2-30
  custom lead groups, 2-25
  global, 2-19, D-10
  main menu, 2-17
  menu structure, 2-17

password, 2-17
patient ID, 2-27
printing settings, 2-32
receive, 2-30
storing, 2-31
transmit, 2-28
Configuration, 2-6
Configuration file jobs menu, 2-31
configuration parameters
AutoCopy, 2-25
battery timeout, 2-26
custom lead groups, 2-25
interpretation, 2-24
line frequency, 2-24
password, 2-26
selecting, 2-19
configured software, 5-10
Configure Site menu, 2-6, 2-28
configuring
LaserJet printing, 2-6
configuring for VCG recording, D-3
Connected to site., C-3
connecting cables for printing, 2-4
connecting fax modem cables, 2-3
connecting the patient module data cable, 2-7, B-2
Connection? None, 2-6
contrast knob
keyboard display, 3-3
patient module display, 3-3
preview screen, 3-3, 5-27
controls
keyboard display contrast knob, 3-3
patient module display contrast knob, 3-3
preview screen brightness knob, 3-3
preview screen contrast knob, 3-3
remote start button ◇, 3-3
controls, front panel, 3-2, 5-22
Copy, 3-3
country options, 1-9
CPU, 5-8
address bus, 5-8
data bus, 5-8
CPU assembly, 5-8
CPU, 5-8
data buffers, 5-8
digital signal processor, 5-14
disk controller, 5-15
I/O control, 5-12
power supply, 5-16
programmable interrupt controller, 5-8
removing, 7-29
replacing, 7-31
ROM, 5-10
system expansion connector, 5-8, 5-15
system memory, 5-10

CPU assembly block diagram, 5-9
CPU assembly test, 4-3
CPU problems, 6-13
current limiting, 5-18
custom 3-lead group, D-10
custom lead groups parameters, 2-25

D

D(0)–D(15) signals, A-8
data bus, 5-8
data cable
  connecting to patient module, 2-7, B-2
`Data Comm`, 2-2
data communications package
  parts list, 8-21
date change display, 2-16
date, changing the setting, 2-16
DCD signal, A-7
DCn signal, A-8
`Defective VCG data`, D-11
delete options, 1-9
DETECTOR signal, A-4
dial type, configuring
  pulse, 2-28
  tone, 2-28
digital signal processor, 5-1, 5-14
  block diagram, 5-15
`Direct Connection`, 2-6
DIRECTION signal, A-10
disabling VCG reports, D-4
disassembling
  the preview screen assembly, 7-13, 7-15
disassembly
  tools required, 7-2
disk
  reformatting, 3-11
  storage space available, 3-11
DISKCHANGE signal, A-10
disk drive, 5-15
  block diagram, 5-15
  problems, 6-16
  removing, 7-31
  removing and replacing, 7-31
  replacing, 7-32
  test, 4-4
disk label, 2-31
display
  alternate main menu, 3-9
  Configuration file jobs menu, 2-31
  configuration menu, 2-17
  Configure Site menu, 2-28
  Configure (transmit), 2-28
  date change, 2-16
  Extended Self-test, 4-2, B-11, C-5
  keyboard, 5-22

main menu, 2-16, 3-4
parameter selection, 2-19
time change, 2-16
Transmit menu, 3-10
documentation options, 1-10
DOOR signal, A-4
DRAM array, 5-10
DRAM gate array, 5-2, 5-10, 5-19
watchdog timer, 5-2
DRV0SEL signal, A-10
DRV1SEL signal, A-10
DRV2SEL signal, A-10
DRV3SEL signal, A-10
DSP, 5-14

E

ECG
receiving, C-4
ECG data path, 5-1
ECG management parameters
cart ID, 2-26
confirmation, 2-26
institution name, 2-26
location code, 2-26
user labels, 2-26
ECG report format
Auto, 3-4
Manual, 3-4
ECGs
receiving, C-3
transmitting, C-3
ECG simulation
recording, 4-8
ECG simulator, 4-8, 6-1
testing with, 4-8
ECG size, 3-3
electrodes
cleaning, 4-13
EMITTER signal, A-4
Enter key ↵, 3-3
error codes, 6-3
error log, 4-14
clearing, 6-2
codes, 6-3
interpreting, 4-7
printing, 4-7
sample printout, 6-2
using, 6-2
errors
1499, software error, 6-6
power-on, 6-7
transmit and modem, 6-20
excluding patient ID entries, 2-27
Extended self-test, 4-2, B-11, C-5
Extended Self-test

All tests, 4-7
CPU assembly test, 4-3
deleting tests, 4-7
disk drive test, 4-4
fax modem test, C-6
keyboard display test, 4-6
modem test, 4-6
patient module and cable test, 4-3, B-12
preview display test, 4-5
printer test, 4-4
printing error log, 4-7
starting, 4-2, B-11, C-5
stopping, 4-2, B-11, C-5
subassembly failure messages, 6-4
test menu, 4-2, B-11, C-5
using for troubleshooting, 6-4

F

fax modem
test, C-6
Fax modem, 2-3
Fax modem cable, 2-2, 2-3
Fax Programmable Modem, C-2
FGA, 5-12, 5-22
baud rate generation, 5-12
data bus arbitration, 5-12
enable and select generation, 5-12
keyboard interface, 5-12
patient module interface, 5-12
system clock generation, 5-12
Filter, 3-3
Find, C-3
flow chart
CPU initialization, 5-3
format, ECG report
Auto, 3-4
Manual, 3-4
formats, D-7
manual report, D-10
"Foundation" gate array, 5-12
FP signal, 5-26, A-11, A-12
front panel, 3-2
fuse
changing, 2-10
rating, 2-10

G
gain accuracy, checking, 4-8
gate array
  DRAM, 5-2, 5-10, 5-19
  FGA ("Foundation"), 5-12, 5-22
  printer, 5-20, 5-22
global configuration, 2-19, D-10
global parameters, 2-20–26
  AutoCopy, 2-25
  battery timeout, 2-26
  custom lead groups, 2-25
  ECG management, 2-26
  interpretation, 2-24
  line frequency, 2-24
  password, 2-26

H
HLDA signal, A-8
HOLD signal, A-8

I
IBIT0 signal, A-8
IBIT2 signal, A-8
(ID), 3-3
IEC leads, D-2
INDEX signal, A-10
indicator lights
  AC, 2-13, 3-3, 5-20, 7-4
  battery level, 2-13, 3-3, 5-20, 7-4
  low battery, 2-13, 3-3, 5-18
initialization flow chart, 5-3
inspection, visual, 4-1
installation, 2-1–16
installing
  software, 2-13, 2-14
  the battery, 2-11
  the cardiograph, 2-1
  the modem, 2-2
  the printer drive gears, 7-11
INT7 signal, A-8
interpretation parameters, 2-24
INTR signal, A-8
I/O control, 5-12
  block diagram, 5-13
  chip select, 5-12
  FGA, 5-12
  read enable, 5-12
  serial communications, 5-14
  UART, 5-14
  write enable, 5-12

K

KBD RESET signal, A-2
keyboard, 3-2, 5-12, 5-22
  cleaning, 4-10
  problems, 6-20
  removing, 7-5
keyboard display, 5-22
  contrast knob, 3-3
  problems, 6-20
  test, 4-6
keys
  Alt, 3-3
  arrow keys ◀ ▶ ▲ ▼, 3-3
  Auto start, 3-3
  Copy, 3-3
  ECG size, 3-3
  Enter key ↵, 3-3
  Filter, 3-3
  ID, 3-3
  Manual start, 3-3
  Menu, 3-3
  On-Standby, 3-3
  Page Advance, 3-3
  softkeys, 3-3
  Speed , 3-3
  Stop, 3-3
  V Leads, 3-3
KRX signal, A-2
KTX signal, A-2

L

LCDDATA signal, A-2
LCDE signal, A-2
LCDON signal, 5-26, A-8
LCDRS signal, A-2, A-8
LCDRW signal, A-2, A-8
LD0–LD3 signal, A-11
LD0–LD3 signals, A-12
LD signal, 5-26
lead status, patient module, 5-6, B-13
leadwires
  cleaning, 4-13
line frequency parameter, 2-24
line fuse
  changing, 2-10
  location, 2-10
  rating requirements, 2-10
line module, 2-8
  opening, 2-9
line voltage, checking the setting, 2-8
loading printer paper, 2-14
logic power, 5-19
logic power, backup, 5-21
look-up table, printer, 5-22
low battery
  disconnect, 5-19

indicator lights, 3-3
shutdown, 5-10, 5-18, 5-20
warning, 5-18
low battery disconnect circuit, 5-21
low battery indicator, 2-13, 5-18
LP signal, 5-26, A-11, A-12
lubrication, 4-9

M

main assembly parts list, 8-5, 8-9
main functions, 3-9
main menu, 2-16, 3-4
maintenance
philosophy, 6-1
preventive, 4-9
Manual report
formats, 3-4
lead selection, 3-4
(Manual), start control, 3-3
menu
alternate main, 3-9
configuration, 2-17
Configuration file jobs, 2-31
Configure Site, 2-28
Configure (transmit), 2-28
Extended Self-test, 4-2, B-11, C-5
main, 2-16, 3-4
Transmit, 3-10
(Menu), 3-3, 3-9
microprocessor, 5-8
MIOn signal, A-8
modem
connection parameter, 2-28
installing on cart, 2-2
problems, 6-20
test, 4-6, C-6
More, C-3
motor driver circuit, 5-22
MOTOR ON signal, A-10
multiplexors, 5-1

N

nADS signal, A-9
nBHE signal, A-9
nBLE signal, A-9
nCTS signal, A-7
nDTR signal, A-7
Next, C-3
nLATCH signal, A-3
nLOCK signal, A-9
NOBATT signal, A-5
noise, 6-11
nONKEY signal, A-2
no VCG report
troubleshooting, D-11
nPSTB signal, A-3

nPVENd signal, A-9
nRD signal, A-9
nRDY signal, A-9
nWAIT signal, A-9
nWEH signal, A-9
nWEL signal, A-9

O

OBIT1 signal, A-9
On-Standby, 3-3
opening the top cover assembly, 7-17, 7-19
options, cardiograph, 1-9–11
  cable, 1-9
  country, 1-9
  delete, 1-9
  documentation, 1-10
  substitute, 1-10, 1-13
  supplies/accessories, 1-10
opto-isolators, 5-6, B-13
ordering information, parts, 8-1
overvoltage monitoring, 5-19

P

P1–P4 signals, A-4
Page Advance, 3-3
paper, loading, 2-14
paper sensor, cleaning, 4-11
paper transport, 5-22
parameters
  AutoCopy, 2-25
  battery timeout, 2-26
  custom lead groups, 2-25
  global, 2-20
  interpretation, 2-24
  line frequency, 2-24
  password, 2-26
parameter selection display, 2-19
parts list, 8-1–21
  cart, 8-20
  data communications package, 8-21
  main assembly, 8-5, 8-9
  patient module, 8-3
  preview display, 8-18
  printer, 8-15
parts ordering information, 8-1
password, configuration, 2-17
password, setting, 2-26
patient data cable
  cleaning, 4-13
  connecting, 2-7, B-2
patient ID
  configuration, 2-27
  excluding entries, 2-27
patient module, 5-1, D-2
  analog-to-digital converter, 5-1, 5-6, B-13
  block diagram, 5-7

cable:test, 4-3, B-12
calibration voltage, 5-6, B-13
connecting the data cable, 2-7, B-2
display contrast knob, 3-3
electrical isolation, 5-6, B-13
lead status, 5-6, B-13
leadwires, 4-8
multiplexors, 5-1, 5-6, B-13
opto-isolators, 5-6, B-13
parts list, 8-3
problems, 6-11
remote start button, 5-6
remote start button ◇|, 3-3
SAECG, B-13
setting up, D-2
test, 4-3, B-12
patient module cable
test, 4-3, B-12
patient module voltage (VFE) regulator, 5-21
patient simulator, 4-8
pause length, 2-28
PCLK signal, A-9
PDOUT signal, A-3
performance verification, 4-1–9
checklist, 4-1, **4-14**
ECG simulation, 4-8, 4-15
Extended Self-test, 4-2, 4-14, B-11, C-5
visual inspection, 4-1, 4-14
phone line connector, 2-3
phone number, entering, 2-28
POWERGND, A-11
power-off sequence, 5-2, 5-10
power-on
problems, 6-7
power-on application
selecting, 2-24
power-on sequence, 5-2, 5-10
power supply, 5-16–21
+5 backup supply, 5-21
+5 overvoltage/undervoltage circuit, 5-19
+5-to-backup switchover circuit, 5-21
+5 volt regulator, 5-19
AC on detector circuit, 5-20
battery charger, 5-18
battery switch circuit, 5-20
battery-to-AC switchover circuit, 5-20
block diagram, 5-17
low battery disconnect circuit, 5-21
patient module voltage (VFE) regulator, 5-21
printer switch circuit, 5-20
system ready circuit, 5-19
tests, 6-22
voltage reference circuit, 5-20
PRCLK signal, A-3
preventing a VCG report, D-5

preventive maintenance, 4-9–13
cleaning, 4-10
lubrication, 4-9
preview display, 5-24–27
assembly block diagram, 5-24
logic board, 5-25
logic board block diagram, 5-25
parts list, 8-18
power supply block diagram, 5-27
preview screen, 5-27
problems, 6-19
static RAM, 5-25
preview display test, 4-5
preview logic board, 5-25, 6-7
block diagram, 5-25
removing, 7-25, 7-27
replacing, 7-28
preview screen, 5-27
brightness knob, 3-3, 5-27
contrast knob, 3-3, 5-27
disassembling, 7-13, 7-15
fluorescent backlighting, 5-27
removing, 7-12, 7-15
replacing, 7-17
Previous, C-3
printer, 5-22–23
analog-to-digital converter, 5-23
block diagram, 5-23
control circuit, 5-22
loading paper, 2-14
look-up table, 5-22
motor driver, 5-22
motor speed, 5-22
paper speed, 4-8
paper transport, 5-22
parts list, 8-15
problems, 6-14
RAM, 5-22
removing the drive assembly, 7-7, 7-9
replacing the drive assembly, 7-11
printer cable, 2-4
printer door
removing, 7-7, 7-9, 7-20, 7-21
printer drive assembly
installing the gears, 7-11
removing, 7-7, 7-9
replacing, 7-11
printer gate array, 5-20, 5-22
printer switch circuit, 5-20
printer test, 4-4
printhead, 4-11, 5-22, 5-23, 7-20
cleaning, 4-11
removing, 7-20, 7-21
replacing, 7-23
resistance, 5-22

resistance code, 7-23
temperature, 5-22
printhead assembly
removing, 7-20, 7-21
printhead cover
removing, 7-9
printing
configuration settings, 2-32
connecting cables, 2-4
the error log, 4-7
VCG, D-4
printing ECGs
on printer, 2-4
programmable interrupt controller, 5-8

Q

QRFEDATA signal, A-6
QRS loops, D-7

R

RAM refresh, 5-10
READDATA signal, A-10
Reading the disk, C-3
real-time counter (RTC), 5-10
receive, configuring
baud rate, 2-30
connection, 2-30
receiving ECGs, C-4
recording a simulated ECG, 4-8
reformatting a disk, 3-11
reinstalling the top cover assembly, 7-20
remote start button ◇, 3-3, 5-6
removing
the battery, 7-2
the CPU assembly, 7-29
the disk drive, 7-31
the keyboard, 7-5
the preview logic board, 7-25, 7-27
the preview screen assembly, 7-12, 7-15
the printer door, 7-7, 7-9, 7-20, 7-21
the printer drive assembly, 7-7, 7-9
the printhead, 7-20, 7-21
the printhead cover, 7-9
the user interface assembly, 7-5
removing the preview logic board, 7-27
removing the printhead assembly, 7-20, 7-21
removing the top cover assembly, 7-18, 7-20
repair philosophy, 6-1
replacing
the battery, 7-4
the CPU assembly, 7-31
the disk drive, 7-32
the preview logic board, 7-28
the preview screen assembly, 7-17
the printer drive assembly, 7-11
the printhead assembly, 7-23

Research leads?, D-10
reset, processor, 5-2
reset vector, 5-2
resistance, printhead, 5-22, 7-23
  setting the selector, 7-23
RFECLK signal, A-6
RFEDATA signal, A-6
RI signal, A-7
ROM, 5-10
routine maintenance, 4-9
RTS signal, A-7
RXD signal, A-7

S
SAECG patient module, **B-13**
  block diagram, B-14
safety standards, 4-13
safety tests, 4-13
sagittal projection, D-7
SCP signal, 5-26, A-11, A-12
Select, C-3
selecting configuration parameters, 2-19
serial communications circuit block diagram, 5-14
setting
  the date, 2-16
  the line voltage, 2-8
  the printhead resistance code, 7-23
  the time, 2-16
setting up the patient module, D-2
SHUTOFF signal, 5-19
SIDE1SEL signal, A-10
signal names
  +5READY, 5-19, 5-26
  ACON, 5-20
  ACONLED, 5-20, A-2
  CHARGEROFF, 5-20
  FP, 5-26
  KBD RESET, A-2
  KRX, A-2
  KTX, A-2
  LCDDATA, A-2
  LCDE, A-2
  LCDON, 5-26
  LCDRS, A-2
  LCDRW, A-2
  LD, 5-26
  LP, 5-26
  nONKEY, A-2
  SCP, 5-26
  SHUTOFF, 5-19
  SWITCHON, 5-20
  SYSRDY, 5-19
  UD, 5-26
  UNITOFF, 5-21
  UNITON, 5-2, 5-19, 5-21

VBATMEAS, 5-20
VLCDEN, 5-26
VREF2, 5-21
signals
+5READY, A-8
A(1)–A(23), A-8
ADS, A-8
BT0, BT1, A-8
D(0)–D(15), A-8
DCD, A-7
DCn, A-8
DETECTOR, A-4
DIRECTION, A-10
DISKCHANGE, A-10
DOOR, A-4
DRV0SEL, A-10
DRV1SEL, A-10
DRV2SEL, A-10
DRV3SEL, A-10
EMITTER, A-4
FP, A-11, A-12
HLDA, A-8
HOLD, A-8
IBIT0, A-8
IBIT2, A-8
INDEX, A-10
INT7, A-8
INTR, A-8
LCDON, A-8
LCDRS, A-8
LCDRW, A-8
LD0–LD3, A-11, A-12
LP, A-11, A-12
MIOn, A-8
MOTOR ON, A-10
nADS, A-9
nBHE, A-9
nBLE, A-9
nCTS, A-7
nDTR, A-7
nLATCH, A-3
nLOCK, A-9
NOBATT, A-5
nPSTB, A-3
nPVENd, A-9
nRD, A-9
nRDY, A-9
nWAIT, A-9
nWEH, A-9
nWEL, A-9
OBIT1, A-9
P1–P4, A-4
PCLK, A-9
PDOUT, A-3
PRCLK, A-3

QRFEDATA, A-6
READDATA, A-10
RFECLK, A-6
RFEDATA, A-6
RI, A-7
RTS, A-7
RXD, A-7
SCP, A-11, A-12
SIDE1SEL, A-10
STEP, A-10
THERM+, A-5
THERM−, A-5
TRK00, A-10
TURBO, A-9
TXD, A-7
UD0–UD3, A-11, A-12
VLCDEN, A-11
WRITEDATA, A-10
WRITEGATE, A-10
WRITEPROTECT, A-11
WRn, A-9
simulator, ECG, 4-8, 6-1
testing with, 4-8
site
AutoDial, 2-30
transmit, 2-28
site number, 2-6
softkeys, 3-3
All, 3-10
AM/PM, 2-16
AutoDial, 2-28, 2-30
CheckDisk, 3-9
Choose, 2-19
Clear, 2-16
Config, 2-17, 3-9
Enter, 2-16, 2-19
ErrorLog, 4-2, B-11, C-5
Exit, 2-16, 2-18, 2-19, 2-28, 2-31, 3-9, 3-10
Files, 2-18, 3-9
Format, 3-4
Global, 2-18, 2-20, 3-9
ID, 2-18, 2-27, 3-9
Leads, 2-19, 3-4
NewGroup, 3-10
Next, 4-2, B-11, C-5
Pause(,), 2-29
Previous, 2-19, 4-2, B-11, C-5
Print, 2-18, 2-31, 3-9
Query, 3-10
Receive, 2-28, 2-30
Report, 3-4
Select, 4-2, 4-7, B-11, C-5
Selected, 3-10
Store, 2-31, 3-9
Tab, 2-19

Test, 4-2, 4-7, B-11, C-5
Tone(W), 2-29
Transmit, 2-18, 2-28, 3-9
software
installing, 2-13, 2-14
storing, 2-31
software error 1499, 6-6
Special applications, D-10
specification, 1-5
specifications, 1-8
ECG to paper, 1-6
environmental, 1-7
miscellaneous, 1-8
patient module, 1-5
physical, 1-5
power supply and battery, 1-6
SAECG patient module, 1-5
Speed, 3-3
speed accuracy, checking, 4-8
standard accessories, 1-10
standard patient module, 5-6
standards
safety, 4-13
STEP signal, A-10
Stop, 3-3, C-4
storing configuration, 2-31
disk label, 2-31
storing the software, 2-31
subassemblies, removable, 7-1
substitute options, 1-10, 1-13
supplies/accessories options, 1-10
SWITCHON signal, 5-20
SYSRDY signal, 5-19
system block diagram, 5-5
system expansion connector, 5-15
system I/O, 5-12
system memory, 5-10
block diagram, 5-11
DRAM array, 5-10
power supply support, 5-10
RAM refresh, 5-10
real-time counter, 5-10
watchdog timer, 5-10
system RAM, 5-1

T

telecommunications package, 1-4
description, 1-4
temperature, printhead, 5-22
test equipment, required, 6-1
test pattern
keyboard display, 4-6
patient module display, 4-3, B-12
preview display, 4-5
printer, 4-4

tests
  CPU assembly, 4-3
  deleting, 4-7
  disk drive, 4-4
  fax modem, C-6
  keyboard display, 4-6
  modem, 4-6, C-6
  patient module, 4-3, B-12
  patient module cable, 4-3, B-12
  power supply, 6-22
  preview display, 4-5
  printer, 4-4
  safety, 4-13
  starting, 4-3
theory of operation, 5-1–27
thermal printhead, 5-23
THERM– signal, A-5
THERM+ signal, A-5
time change display, 2-16
time, changing the setting, 2-16
tools for disassembly, 7-2
top cover assembly, 7-17
  opening, 7-17, 7-19
  reinstallation, 7-20
  removing, 7-18, 7-20
transmit
  problems, 6-20
Transmit, 2-6, C-3
transmit configuration, 2-28
transmit, configuring
  baud rate, 2-28
  connection, 2-28
  dial type, 2-28
  pause length, 2-28
  phone number, 2-28
Transmit menu display, 3-10
transmit site, 2-28
  phone number, 2-28
transmitting
  ECGs, C-4
  via fax, C-3
Transmitting 1 of 1 ECG(s), C-3
transmitting ECGs, C-3
Transmitting ... , C-3
TRK00 signal, A-10
troubleshooting, 6-1–24, D-10
  Defective VCG data, D-11
  Extended Self-test, using, 6-4
  noise problems, 6-11
  no VCG, D-11
troubleshooting tables, 6-5–21, C-7
  CPU assembly, 6-13
  disk drive, 6-16
  flowchart, 6-6
  keyboard and keyboard display, 6-20

patient module and cable, 6-11
power supply and battery, 6-9
preview display and logic, 6-19
printer, 6-14
transmit and modem, 6-20
TURBO signal, A-9
TXD signal, A-7

U

UART, 5-14
UD0–UD3 signals, A-11, A-12
UD signal, 5-26
undervoltage monitoring, 5-19
UNITOFF signal, 5-21
UNITON signal, 5-2, 5-19, 5-21
upgrade kits, 1-11
user interface assembly, removing, 7-5

V

V3R, V4R, V7, D-10
VBACK, 5-21, 6-22
VBACK7, A-9
VBAT, 5-18, 5-20, 6-22
VBAT+, A-5
VBATMEAS signal, 5-20
VBAT–, A-5
VCC, 5-26
VCCFILT, A-12
VCFL, 5-27
VCFL1, 2, A-12
VCFLRET, A-12
VCG
printing, D-4
report formats, D-7
VCG?, D-11
VCG1, D-7
VCG2, D-7
VCG3, D-7, D-8
VCG4, D-7, D-8
VCG recording
configuration, D-3
VCG report, D-6
disabling, D-4
preventing from printing, D-5
VFE, 5-21, 6-23, A-6
VFE regulator, 5-21
VIN, 5-16, 5-20, 5-26, 6-22, A-9, A-11
visual inspection, 4-1
VLCD, 5-27, A-12
VLCD , A-2
VLCDEN signal, 5-26, A-11
V Leads, 3-3
VMAIN, 5-16
voltage reference circuit, 5-20
voltage regulator
+5 volt, 5-2, 5-19

VFE (patient module), 5-21
voltages
+5V, 6-23, A-3, A-8, A-9, A-10
+5VF, A-11
5VREF, A-3
POWERGND, A-11
power supply, 6-22
VBACK, 5-21, 6-22
VBACK7, A-9
VBAT, 5-20, 6-22
VBAT+, A-5
VBATMEAS, 5-20
VBAT−, A-5
VCC, 5-26
VCCFILT, A-12
VCFL, 5-26
VCFL1, 2, A-12
VCFLRET, A-12
VFE, 5-21, 6-23, A-6
VIN, 5-16, 5-19, 5-20, 5-26, 6-22, A-9, A-11
VLCD, 5-26, A-2, A-12
VMAIN, 5-16
VPRINT, 5-20, 6-23, A-4, A-5
VREF25, 5-20
VTHERM, A-3
voltage test locations, 6-23
VPRINT, 6-23, A-4, A-5
VREF2 signal, 5-21
VTHERM, A-3
VX1, VX2, VX3, VX4, D-10

W

watchdog timer, 5-2, 5-10
WRITEDATA signal, A-10
WRITEGATE signal, A-10
WRITEPROTECT signal, A-11
WRn signal, A-9

Reader Comment Card

We welcome your evaluation of this manual. Your comments and suggestions help us improve our publications.

Manual Title and/or Part Number _____

Please circle one number for each of the statements below.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
■ The manual is well organized.	1	2	3	4	5
■ I can find the information I want.	1	2	3	4	5
■ The information in the manual is accurate.	1	2	3	4	5
■ I can easily understand the instructions and procedures.	1	2	3	4	5
■ The manual is clearly written.	1	2	3	4	5
■ The manual contains enough examples.	1	2	3	4	5
■ The examples are appropriate and helpful.	1	2	3	4	5
■ The layout and format are attractive and useful.	1	2	3	4	5
■ The illustrations are clear and helpful.	1	2	3	4	5

Please feel free to write additional comments, particularly if you disagree with a statement above. Use additional pages if you wish—the more detailed your comments, the more useful they are to us.

Comments: _____

Name: _____

Title: _____

Company: _____

Address: _____

City/State/Zip: _____

Phone: _____

Please tear out and mail in.

HEWLETT PACKARD

Fold Here
Tape edges for mailing

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS MAIL PERMIT NO. 85 MCMINNVILLE, OREGON

POSTAGE WILL BE PAID BY ADDRESSEE

HEWLETT-PACKARD COMPANY
Cardiology Business Unit
ATTN: Quality Assurance
1700 South Baker Street
McMinnville, OR 97128-9196